REMARKS

Status of Application

Claims 1-5, 7-10, 12-15 and 17-20 were pending in this application. In the Office Action mailed November 12, 2008, claims 1-5, 7-10, 12-15 and 17-20 were rejected.

By this amendment, claims 10, 14, 15 and 17-19 are pending as currently amended. Claims 1-5, 7-9, 12, 13 and 20 are pending as previously presented. Claims 6, 11 and 16 are cancelled. No new matter is introduced by these amendments, which are fully supported by the specification.

Applicant requests consideration and allowance of claims 1-5, 7-10, 12-15 and 17-20.

Applicant reserves the right to prosecute any withdrawn, cancelled, or non-elected claims and/or subject matter in separate applications.

35 U.S.C. § 101 Rejections

Claims 10, 12-15 and 17-19 were rejected as not falling within a statutory category of invention. Applicants have amended independent claim 10 to provide the appropriate transformation. Thus, these rejections can be withdrawn.

35 U.S.C. § 112 Rejection

Claim 20 was rejected as failing to comply with the written description requirement for use of the term "computer readable storage medium."

Applicants respectfully traverse this rejection and point to support in the specification in the use of terms such as "computation" (see page 3, lines 12 and 15), "data processing device" (page 3, lines 1 and 14-15), "computing" and "computer" (see page 9, line 13), "calculation of a sum profile" (see page 5, line 3, and page 7, line 21), "spatial position of C_{3D} could then be calculated" (see page 7, lines 6-7), "calculated by the projection matrix"

(see page 8, line 5), as well as incorporation of the inventor publication "Single Projection Modeling" by B. Movassaghi, V. Rasche, M.A. Viergever and W. J. Niessen (Medical Image Computing and Computer Assisted Interventions - MICCAI-Conference 2003) (see page 9, lines 11-15).

These descriptive terms clearly imply the use of a computer readable storage medium comprising instructions of the type which is typically used to perform such calculations and computations, and is typically present in such computers. For example, a "sum profile" and "projection matrix" would normally be stored in a medium to perform the recited calculations. A person of ordinary skill in the art would immediately recognize computer readable media such as disks, memory, and other volatile or non-volatile storage devices or systems usable by the computer.

There is no *in haec verba* requirement for written description, and claim limitations may be supported in the specification through express, implicit, or inherent disclosure. See MPEP § 2163. Applicants herein amend the specification to provide the claim language "computer-readable storage medium comprising computer instructions" in the specification under MPEP § 608.01(o).

Applicants respectfully suggest that this rejection may be withdrawn.

35 U.S.C. § 102 Rejections

Applicants note with appreciation the withdrawal of the rejection of claims 1-20 as being anticipated by Hoffman et al., "Biplane X-ray Angiograms, Intravascular Ultrasound, and 3D Visualization of Coronary Vessels," Int'l J Cardiac Imaging, Vol. 15, No. 6, Dec. 1999, pp. 495-512 (hereinafter "Hoffman et al.").

35 U.S.C. § 103(a) Rejections

Claims 1-5, 7-10, 12-15 and 17-20 were rejected as unpatentable under 35 U.S.C. § 103(a) over Hoffman et al. in view of Yoshigahara et al., U.S. Patent No. 7,015,951 ("the '951 patent"). Applicants respectfully traverse these rejections.

To begin, significant differences exist between Applicants' invention and Hoffman et al. In general, Applicants' invention of claims 1-5, 7-10, 12-15 and 17-20 is a faster and more reliable and efficient device and methodology which provides a superior three-dimensional model of a spatial structure such as a vascular structure over that of Hoffman et al. For example, Hoffman et al. discloses at pages 497-98, in the known methods, bifurcation points of the vascular tree are used as an initial estimate of the imaging geometry, and the 3D-positioning is determined by triangulation for which the rotation and translation of the image data is done to "minimize the differences between the input image data and the projections of the calculated 3D points into the image plane in a non-linear manner." (see Hoffman et al. at 498) As Hoffman et al. further describe, using this triangulation methodology, "the 3D positions of the entire vascular tree are calculated." (see Hoffman et al. at 498, right column)

To the contrary, Applicants describe that the triangulation method for two images is disadvantageous because manually finding the corresponding points on two projections is difficult. (see specification at page 7, lines 4-9) Applicants describe a method which advantageously utilizes a number $\underline{n}$ of projection images. (see specification at page 7, lines 10-12, and page 8, equation 3) This method is efficient because space points are determined from a sum profile by "constructive superimposition" wherein the "position of the gray-value minimum in the sum profile S can consequently be defined as the actual spatial position …" (see specification at page 7, lines 26-30) Applicants further describe that the "property of having an extreme gray value [] is, as a rule, preserved well in the various projections." (see specification at page 4, lines 4-5)

In sum, while Hoffman et al. "minimize the differences" between an image and projections, Applicants constructive superimposition calculation and method utilizes a gray-

value minimum in the sum profile S. Thus, Applicants' invention differs significantly from the Hoffman et al.

The Examiner pointed to the right portion of Fig. 3 of Hoffman et al. as disclosing "minimum values, extremes, of the sum profile are mapped to the vascular structure." (see Office Action at 6) However, Hoffman et al. disclose, referring to Fig. 3, only that "[e]ach cross section is subsequently reconstructed from its two 1D projection profiles." (Hoffman et al. at 500, right column, emphasis added) To the contrary, Applicants' invention utilizes a sum profile which gives a superior result because by constructive superimposition using multiple projections "the contributions of other vascular segments are destructively added, that is to say essentially averaged out." (see specification at page 7, lines 27-28) A further advantage of using this type of sum profile is that "projection images originating from other movement phases [of the heart activity] may also be used since their possibly geometrically inconsistent contributions are averaged out" so that an additional ECG is not necessary (see specification at page 5, lines 2-9)

In short, Hoffman et al. do not disclose the limitation "wherein the space point is reconstructed by evaluating other image points of the further projection images that lie on a respective epipolar line of the reference point, wherein gray scale values corresponding to the other image points are projected on a projection line of the reference point and added to form a sum profile and wherein said space point is defined as that position on the projection line of the reference point at which the sum profile assumes an extreme" as described in claim 1 of Applicants' invention. Thus, independent claims 1, 10 and 20 are patentable over the cited references.

Furthermore, significant differences exist between Applicants' invention and the '951 patent. In general, Applicants' invention of claims 1-5, 7-10, 12-15 and 17-20 is a faster and more reliable and efficient device and methodology which provides a superior three-dimensional model of a spatial structure such as a vascular structure over that of the '951 patent.

An important difference is that Applicants' method is interactive and uses a number of reference points selected by the user or physician, which correspond to structural features of interest, whereas the '951 patent consistently refers to calculations for each pixel of the pertinent images.

Another important difference is that Applicants' more efficient method uses a calculation involving one-dimensional gray value profiles that are each obtained from an epipolar line of a projection image where each epipolar line corresponds to one of a number of selected reference points (see Applicants' specification at page 7, lines 13-30). To the contrary, the '951 patent uses a "picture matching method" that calculates "error in luminance" for each pixel of each projection image with respect to the reference image (see col. 6, lines 45-59, and Fig. 10). Thus, Applicants' invention differs significantly from the '951 patent.

Another important difference is that Applicants' more efficient method obtains a summation one-dimensional gray value profile that has an extreme value or "minimum" that is used to determine the corresponding spatial position of the reference point and to provide the three-dimensional model (see Applicants' specification at page 7, lines 21-30). To the contrary, the '951 patent uses the known "Levenberg-Marquardt minimum method" in the "picture matching method" (see col. 6, lines 58-59). Applicants respectfully suggest that the "minimum" of the "Levenberg-Marquardt minimum method" of the '951 patent is based on "error" minimization comparison of each pixel of each projection image with respect to the reference image, and is unrelated to the extreme value of the summation one-dimensional gray value profile used in Applicants' method. Thus, Applicants' invention differs significantly from the '951 patent.

In essence, Applicants' invention would not have been obvious in light of the significant differences between Applicants' invention and the cited references. Further, the Examiner has not pointed to evidence in the references, or any other reason showing that one would have been motivated to combine the cited references. Examiner suggests that the "modification [of Hoffman et al. with the '951 patent] would have been prompted in order to clarify the teachings of Hoffman et al." Applicant respectfully submits that "clarifying" is not a motivation at all.

Lastly, Applicants submit that for the same reasons as discussed above, dependent claims 2-5, 7-9, 12-15 and 17-19 are patentable.

In conclusion, Applicants' invention described in claims 1-5, 7-10, 12-15 and 17-20 is patentable over Hoffman et al. in view of Yoshigahara et al.

CONCLUSION

Applicants respectfully submit that claims 1-5, 7-10, 12-15 and 17-20 distinguish patentably from the references of record and are in condition for allowance.

Should any questions remain, Examiner is invited to telephone Applicants' representative at the number provided.

Respectfully submitted,

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